U. S. DEPARTMENT OF AGRICULTURE.
OFFICE OF EXPERIMENT STATIONS.

COTTON CULTURE IN EGYPT.

BY

GEORGE P. FOADEN, B. Sc.,
PROFESSOR OF AGRICULTURE, TEWFIKIEH COLLEGE OF AGRICULTURE, GHIZEH, EGYPT.

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., February 27, 1897.

SIR: I have the honor to transmit herewith an article on cotton culture in Egypt, by George P. Foaden, B. Sc., professor of agriculture at the Tewfikieh College of Agriculture, Ghizeh, Egypt. This article has been prepared under my direction, with a view to giving the cotton planters in this country accurate information regarding the conditions under which cotton is grown in Egypt. The interest of the subject to American growers and manufacturers of cotton is made clearly apparent by the addition to Professor Foaden's article in the present publication of a review by Mr. F. H. Hitchcock, chief of the Section of Foreign Markets of this Department, on the growing importance of Egypt as a cotton exporting country.

Tests of varieties of Egyptian cotton have been made in a number of localities in this country, but it is not yet clear that these varieties can be successfully grown within the limits of the United States.

This article is transmitted with the recommendation that it be published with Mr. Hitchcock's article as Bulletin 42 of this Office.

Respectfully,

A. C. TRUE,
Director.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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COTTON CULTURE IN EGYPT.

PRESENT CONDITION OF COTTON CULTURE IN EGYPT.

It is extremely difficult to obtain reliable statistics of the Egyptian cotton crop, because the native cultivators have a great objection to giving information on the subject, always suspecting that the figures are required for taxation purposes. Estimates, however, are prepared by both the irrigation officers and the finance ministry of the Egyptian Government. From the latest returns issued as the average of these two estimates the annual production of cotton in Egypt may be taken as 5,500,000 cantars[1] of unginned cotton and the area under the crop as about 1,200,000 acres. This furnishes about 550,000,000 pounds of fiber, practically all of which is exported, and 22,275,000 bushels of seed, the greater part of which is exported.

The average prices obtained for cotton in Egypt during past years are as follows:

Price of unginned cotton in Egypt, 1888–1895.

Year.	Price per cantar.	
	Piasters.	
1888 (September 1, 1888, to August 31, 1889)	272	$13.60
1889	268	13.40
1890	227	11.35
1891	178	8.90
1892	187	9.35
1893	178	8.90
1894	192	9.60
1895	223	11.15

The total value of the crop in 1888–89 was $35,757,450, and in 1895 $56,623,724, an increase of $20,866,274 in spite of a fall of 20 per cent in prices.

An increased supply of water during the summer will mean an increase in the cotton area, and the means of securing this are at present under consideration. The construction of an immense reservoir in Upper Egypt is contemplated, which will be gradually filled during high Nile, and when once filled will be used to supplement the small quantity of water which the Nile gives during summer previous to its rise. The cotton crop is very dependent on this summer water, and within a few years it is hoped that this reservoir will be constructed and be the means of increasing the area now devoted to cotton and other summer crops. In many places during the past few years the area under cotton

[1]The term cantar is here used to designate the amount of unginned cotton which yields approximately 100 pounds of fiber, viz. 315 pounds, as explained on p. 26.

has been greatly increased, and the next "low" Nile will mean insufficient water to irrigate the crop. Much land in the delta requires drainage to enable it to grow good cotton, but at present if drained there would not be a sufficient supply of water to irrigate it during summer, so that the question of water storage claims first attention. This does not alter the fact, however, that much well-irrigated land requires drainage to enable it to grow more and better cotton.

A great deal of land has been drained since the irrigation department of the Egyptian Government has been placed under the management of English engineers. During the past ten years 1,349,143 acres have been drained at a cost of $2,098,407.70, and there still remains more than 3,000,000 acres to drain.

In the southern part of the delta, near the lakes, a very large area of land has yet to be reclaimed. Owing to its situation (being either below or but very little above the level of the Mediterranean) and to the fact that there is no drainage, it is extremely salt. At present much of the land is being washed and drained. After four or five years of this treatment it grows fair cotton. There can be no doubt that in time the whole of it will be reclaimed. The extent of this area can not be stated definitely, since an accurate survey of the whole of Egypt is now being made for the first time.

CROPS GROWN IN EGYPT.

The crops of Egypt may be divided into three classes, according to the seasons at which they are sown. The *Shitwi*, or winter crops, to which belong wheat, barley, beans, lentils, clover, flax, etc., are sown between the months of October and February. The *Sefi*, or summer crops, including cotton, sugar cane, sesame, peanuts, indigo, etc., are planted from March to July. The *Nili*, or flood crops, such as maize, millet, and rice, are planted from July to October.

The very different climatic conditions prevalent at these seasons enable the cultivator to grow a great variety of products, and, aided as he is by a comparatively high temperature and a plentiful supply of water, he is able to obtain two or three crops from the same land every year. The seasons vary but little from year to year, a fact of considerable importance in the cultivation of such crops as cotton and sugar cane.

CLIMATIC CONDITIONS.

Before proceeding to discuss the cultivation and general management of the cotton crop, we propose to deal with the climatic conditions under which it is grown. Sown generally by March 20, it occupies the land for a period of eight or nine months, and is subjected to considerable variations in temperature before it is finally removed from the soil in November.

The young plants appear above the ground in the latter half of March or the beginning of April, in from eight to fifteen days after planting.

For four months they experience a gradually increasing temperature, which reaches its maximum in the latter part of July or beginning of August. The following table gives the average shade temperature, taken at regular intervals during the day, of the various months of the year:

Average shade temperatures during different months.

Month.	3 a. m.	6 a. m.	9 a. m.	Midday.	2.14 p. m.	3 p. m.	6 p. m.	9 p. m.	Midnight.
	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
January	45.6	43.9	52.5	64.4	67.3	67.0	59.4	53.4	49.0
February	51.5	50.8	59.3	70.7	73.4	73.3	66.7	61.5	56.2
March	52.4	50.6	61.6	70.4	73.0	73.0	66.1	59.0	54.8
April	58.7	58.0	71.0	81.0	75.5	82.4	76.4	67.9	62.2
May	63.3	64.7	78.4	87.7	90.0	89.5	82.0	73.0	67.7
June	65.3	67.8	78.8	88.8	91.4	92.2	87.3	76.6	69.5
July	69.8	71.4	81.6	92.5	95.9	96.0	92.6	82.0	74.8
August	70.7	71.3	80.6	88.7	94.4	92.0	87.9	79.3	73.7
September	66.4	55.6	77.8	86.0	87.8	87.4	80.5	73.5	68.9
October	62.0	60.8	72.2	80.0	80.6	81.6	74.0	69.0	65.2
November	56.4	55.4	64.0	73.0	74.6	73.7	66.7	62.5	59.0
December	51.8	50.2	56.8	66.0	67.8	67.3	60.6	56.8	54.0

From this it is seen that the midday temperature rises from 70.4° F. in March to an average maximum of more than 92.5° F. in July. The variations which take place between the day and night temperatures are seen to be very considerable.

The temperature of the soil at all depths up to 4 feet reaches its maximum in August, as will be seen from the following table of observations taken at midday:

Soil temperatures at different depths.

Month.	9.75 inches.	21.10 inches.	33.25 inches.	45 inches.	Month.	9.75 inches.	21.10 inches.	33.25 inches.	45 inches.
	° *F.*	° *F.*	° *F.*	° *F.*		° *F.*	° *F.*	° *F.*	° *F.*
January	59.6	62.9	65.3	67.9	July	86.7	85.4	83.0	80.5
February	64.0	65.5	66.2	67.1	August	86.7	86.5	84.8	82.7
March	65.4	67.8	67.8	68.3	September	82.3	83.7	83.3	82.4
April	70.7	71.0	70.4	70.0	October	76.6	78.8	79.4	79.6
May	77.8	77.0	75.0	73.4	November	69.8	73.0	74.7	75.9
June	82.4	81.6	79.6	77.5	December	63.5	67.0	69.0	71.0

The temperature of the soil thus gradually increases from March to August, and then gradually declines.

The humidity of the atmosphere in Egypt is continually undergoing change, and to a greater extent than in European countries. The cotton plants for the first five months of their growth live in a comparatively dry atmosphere. For three months the amount of water vapor diminishes, reaching its minimum in May, when it is 24.7 per cent of the total water-holding capacity of the atmosphere. From this point it rises until in August the percentage has increased to 43.6. Before this period arrives the flowering stage has passed to a great extent, the young bolls have formed, and some have begun to open. The plants continue to grow in this hot and moist atmosphere until September, when picking begins, generally about the 10th of the month.

The following table shows the humidity of the atmosphere for each month of the year, being represented as percentages of the total water-holding capacity:

Humidity of the air during different months in Egypt.

	Per cent.
January	41.1
February	34.1
March	34.1
April	30.1
May	24.7
June	32.4
July	32.8
August	43.6
September	44.1
October	46.5
November	52.8
December	52.5

During the month of September and the early part of October, while the crop is still maturing, the atmospheric conditions undergo a slight change—the humidity increases, while the temperature falls. This in fact continues for the next two months, only to a greater extent. In November the fall in temperature is so marked, as a rule, that the ripening of the remaining bolls proceeds very slowly, and many never open at all. Though the temperature declines, the humidity increases, owing to the Nile remaining in flood. The river rapidly falls in November, and from this point the amount of moisture in the air diminishes.

Although the crop has sometimes to contend against adverse climatic changes, on the whole it may be said that the risks from this cause are small compared to insect attacks, especially the cotton worm and the bollworm (see pp. 22, 24). The tendency has been for the past few years toward early planting because it is thought that a greater percentage of the bolls will then open and the liability to attack by worms diminish. Unfortunately, however, the plants then occasionally get a check owing to a few cold days in spring. They are very sensitive to the cold winds which sometimes sweep through the delta early in March. This delays the date of the first picking, and many of the bolls which would otherwise have opened become useless, and are found on the bottom stalks when they are cut and removed from the soil. During the summer months no fears are entertained as far as climatic conditions are concerned; all that is required is a supply of water and judicious application of it. In October the second picking is obtained. The third, obtained in November, is a light one, for during this month and the preceding one not only are the morning and evening temperatures low, but fogs are prevalent, which are fatal to the ripening of the remaining bolls.

As regards rain, it may be said that almost none falls from the time the crop is planted until the last picking is obtained early in November. The small amount which does fall in Egypt is confined chiefly to the months of November, December, January, February, and March; but

it is rare that rain falls in any quantity after the cotton is above the ground. Occasionally in April there is a shower, though not in sufficient quantity to cause any injury to the young plants. A moderate shower seems to be beneficial, although most cultivators prefer to raise the crop without any rain at all. It does not cause any damage at any time to cotton in first leaf, but, if occurring late, as in May, it may result in slight damage, especially to early planted crops on poor land. The rainfall at Alexandria is much greater than at Cairo, both places being within the great cotton-growing area. As already explained, however, nearly the whole of the rain falls during the winter, when cotton does not occupy the land.

The following table shows the average amount of rainfall at Cairo and Alexandria during each month of the year:

Average rainfall during different months at Cairo and Alexandria, Egypt.

Month.	Cairo.	Alexandria.	Month.	Cairo.	Alexandria.
	Inch.	*Inches.*		*Inch.*	*Inches.*
January	0.22	1.86	July	.....	.....
February	.10	.63	August	.....	.....
March	.12	.98	September	.....	0.09
April	.10	.07	October	.....	.11
May	.01	.05	November	0.64	1.77
June	.....	.....	December	.31	2.24

The results are the average of many years' observations. It is a fact worthy of notice that during the past few seasons a greater amount of rain has fallen during March and April than usual, while even in May a heavy shower has not been unusual.

Such, then, are the climatic conditions under which the crop is grown. There can not be much doubt that the hot, moist atmosphere prevalent during ripening has much to do with the production of that fiber for which the country is famous. Another fact of importance is that the quantity of water which the plants receive is under perfect control. The amount of irrigation water given and the times of its application are most important factors in the successful growth of the crop, and it is extremely likely that a moist atmosphere, caused by rapid evaporation at the time of the Nile flood, has a more important bearing on the production of long, strong fibers than has generally been supposed. If cotton be irrigated irregularly—that is, if water be withheld at one period and excess given at another—the fibers are checked in growth; and although it recommences when water is given, the lint is inferior, being short and extremely weak and brittle. We have every reason, therefore, to believe that this hot, moist atmosphere at the time of ripening is closely connected with the length of the fiber at least, and probably also with its strength.

During August, September, and October, months in which fiber development is very active, the whole of the great cotton-growing district of Egypt (the delta of the Nile) is very moist. A very large area is flooded, and all lands are more or less wet some distance below the

surface from infiltration water. Such a condition, when accompanied by a high temperature, must be described as "forcing." When the river falls, the atmosphere becomes cooler and the opening of the bolls proceeds more slowly.

SOILS.

The soils of Egypt are all alluvial and, generally speaking, very fertile. From the nature of their formation it is easily understood that great variations, both as regards mechanical condition and chemical constitution, occur. Near the river more or less sandy soils are seen; but as we recede, heavy clays prevail, increasing in tenacity until finally the desert is reached. The cultivated land in Egypt extends about 4 miles on each side of the river. It is almost impossible to imagine any clays more dense than those found in many places, while in close proximity almost pure sands may be seen. In fact, on the same farm great variations often occur, especially if situated near the river, where during the formation of the land strong currents existed.

A clayey loam best describes the great majority of the soils of Lower Egypt. In the upper division of the country, where cultivation is less intensive, they are as a rule more dense. Practically speaking, none of the good grades of cotton are grown in Upper Egypt. In the delta, and especially in those provinces where the best cotton is grown, we find that suitable admixture of clay and sand so common in alluvial soils in many parts of the world, and this is invariably accompanied by a considerable quantity of vegetable matter, owing to the large quantity of green fodder (clover) grown. The soil distinctly inclines to a clay, and bakes and cracks under the influence of the summer sun.

Very sandy soils are not at all suited to cotton in this region. They hold and retain too little of the irrigation water applied, and the fiber they produce is deficient both in quantity and quality. The heavy clays, on the other hand, are not best for the growth of cotton. They produce a large quantity of wood, the crop is late in coming to maturity, and a greater percentage of the bolls remain unopened. Cultivators prefer a loamy soil, yellowish black in color, rather than the dark, heavy clays found in many places. In any case a good depth of soil is considered necessary. This is not wanting in Egypt, for when excavations are made for any purpose it is generally found that the soil is more or less uniform for a depth of many feet, and, as might be expected, there is an entire absence of stones.

Regarding the chemical composition of the soils of the cotton-growing district much might be written. The Nile, in its flow from the lakes of central Africa to the sea, passes through districts whose geological features are so vastly different that, as we should expect, Nile mud is very complex and well stocked with mineral ingredients.

As far as can be ascertained, there is no deficiency of phosphoric acid or potash in the great majority of the soils of Egypt, and these substances are never, or but very rarely, applied in the form of artificial fertilizers. Lime is present in considerable quantities, generally not

less than 3 or 4 per cent, rising in some instances to as much as 8 or 9 per cent. Magnesia also is present to the extent of 2 or 3 per cent.

In spite of the fact that clover is grown to such a great extent, occupying, as it does, one-third of the total area, the soils are more benefited by nitrogenous manures than any others. The poverty of many of the soils in nitrogen is due to the large growths of cotton and sugar cane, crops which are entirely removed from the land and return practically nothing, either as residue or in the form of manure.

The following table shows the results of analyses of typical cotton soils made by Dr. Mackenzie, professor of chemistry at the Tewfikieh College of Agriculture:

Analyses of typical cotton soils of Egypt.

	1.	2.	3.	4.	5.	6.	7.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Insoluble matter and silica	61.01	57.01	58.58	57.97	58.17	59.11	60.78
Potash	.72	.87	.67	1.88	1.85	1.75	.82
Soda	1.31	.79	.79	2.16	1.89	1.94	1.51
Lime	3.34	2.27	3.28	3.39	8.02	7.86	4.45
Magnesia	1.99	2.95	2.73	2.57	3.27	3.10	2.79
Iron oxid	9.84	11.69	11.33	9.78	5.47	5.61	10.21
Alumina	12.66	14.47	13.03	11.68	8.68	7.62	9.84
Phosphoric acid	.25	.36	.24	.29	.70	.55	.28
Sulphuric acid	.22	.19	.25	.36	1.66	1.83	1.24
Chlorin	.89	.12	.77	1.60	1.53	1.50	.91
Manganese oxid	.09	.06	.13	.21	.09	.12	.11
Carbon dioxid	1.05	.48	1.17	1.05	4.11	4.77	2.41
Organic matter	6.62	8.38	6.99	6.90	4.51	4.19	4.64
Nitrogen	.479	.205	.115	.436	.206	.202	.26

These soils are of good quality. The percentage of nitrogen they contain is on an average high, but, owing to the rapidity with which nitrification goes on during the whole year, much of the nitrogen which accumulates in the soil is in an insoluble condition, and many soils, though showing on analysis a considerable percentage of nitrogen, are benefited by nitrogenous manures. Potash and phosphoric acid are present in sufficient quantities. In some poor soils which have been examined nitrogen has been found as low as 0.08 per cent, but potash has never fallen below 0.6, nor phosphoric acid below 0.2 per cent.

A considerable area of land in the delta is now in process of washing and reclamation to remove the excess of soluble salt which it contains, amounting in some cases to 10 per cent. It is a fact worthy of notice that the percentage of sodium chlorid present in the majority of the soils of the cotton-growing district is somewhat high. The average of the analyses already given is more than 1.5 per cent, and it may certainly be said that in the great majority of soils 1 per cent and over would be found. Where the land is about 23 feet above the level of the Mediterranean it is free from salt in excess, but below this contour bad drainage is accompanied by saline efflorescences. Below a 10-foot contour salt is everywhere in excess, and most careful drainage, with frequent washing, is necessary. Below 5 feet the land is barren.

A small percentage of salt is said to exercise a beneficial effect on the strength and color of the fiber. If a slight excess be present, as in the district around Alexandria, the plants are small and the fiber, though not of good quality, is not so inferior as might be expected. It is of fair strength, but rather short. A fact of interest is that on such lands the crop is early, and even where the plants are likely to be killed by the excess of salt they make a violent endeavor to reproduce themselves before dying.

DRAFT OF EGYPTIAN COTTON ON THE FERTILITY OF THE SOIL.

It may be assumed that an average crop of Egyptian cotton yields 5,000 pounds of wood in a green state per acre. This seems excessive compared with American figures,[1] but as a matter of fact it often amounts to more than this, especially with a large-growing variety, such as Bamia. The quantity of water the wood contains is also high. After the last picking it amounts to 60 per cent.

It may be interesting to give the result of analyses made by Dr. Mackenzie of the ash of the wood, seed, and fiber for comparison with the American figures.

Fertilizing constituents of Egyptian cotton stems, seed, and fiber.

	Stems.	Seed.	Fiber.
	Per cent.	*Per cent.*	*Per cent.*
Nitrogen	0.18	3.70	0.20
Ash	1.74	3.40	1.33
Composition of ash:			
Potash	32.90	32.30	35.50
Soda	5.45	6.90	3.64
Lime	28.00	5.60	14.63
Magnesia	6.30	16.50	8.78
Oxid of iron	.....	.....	6.56
Phosphoric acid	8.10	31.10	8.34
Sulphuric acid	5.40	2.10	7.77
Silica	5.90	.30	8.22
Chlorin	7.50	1.50	6.57

On the basis of these figures it is estimated that the following amounts of nitrogen, phosphoric acid, and potash are removed from 1 acre by a crop yielding about 600 pounds of lint per acre:

Fertilizing constituents in a crop of Egyptian cotton.

[Pounds per acre.]

	Nitrogen.	Phosphoric acid.	Potash.
Wood (5,000 pounds)	9.00	7.00	28.60
Seed (1,300 pounds)	48.10	13.70	14.20
Fiber (600 pounds)	.20	.66	2.84
Total	58.30	21.36	45.64

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 33, p. 83.

When the wood is cut it bears practically no leaves. There are a number of unopened bolls which are more or less green, and also a few dried valves of the bolls from which the cotton has been gathered. The value of the wood as it stands in the field is about $2 per acre. It is used as fuel for engines, the latter being chiefly used for raising water, thrashing grain, ginning cotton, etc.

PREPARATION OF SOIL AND MANURING.

Having now dealt in some detail with soil and climate, we propose to treat of the management of the land preparatory to the sowing of the crop and to add a few remarks on the subject of manuring. The treatment may be said to begin after the removal of the winter crop from the land (April to June). In some cases, on poor soils, the land is allowed to remain fallow until the planting of cotton in the following March—that is, for nine months. This, though practiced in a few instances, must be regarded as an exception to the general rule. Sometimes the land is fallowed until October, when clover is sown, which occupies the land until the time for planting cotton arrives (March). It is then plowed up in preparation of the land for the fiber crop.

The usual system may be described thus: After the wheat, barley, beans, or clover has been removed from the soil, the land remains fallow until the end of July (a period of from one to two and one-half months). In the beginning of this month the land is watered and when sufficiently dry (after six or eight days) plowed. Maize is then sown and harrowed in. Some sow the crop without a previous plowing, but this is to be condemned, for the grain crop suffers and also indirectly the succeeding cotton. The maize crop is almost invariably manured somewhat heavily in Egypt, and if barnyard manure be used the following cotton crop undoubtedly receives a part of the benefit. This manure is not, however, in general use for maize, but a substance found in great quantities in nearly every district, consisting of the remains of ancient villages mixed with broken pottery and other débris. Fifteen or 20 tons of this material is commonly used. Its composition varies greatly, but we may take as an average 0.25 to 0.30 per cent of nitrogen (nearly the whole of which is in the nitric form), 0.5 to 0.7 per cent of phosphoric acid, and 1.5 per cent of potash.

Maize remains on the soil until November, a period of ninety to one hundred and twenty days, according to the variety. It receives during its growth four or five waterings; and it must be borne in mind that the Nile is now high and the water charged with matter in suspension, giving it a reddish color. One or two hoeings are also given, and the plants thinned by hand.

About eight days before the maize is cut it receives a heavy watering and clover seed is broadcasted among the standing crop. When the corn is removed the clover is above the ground, and about fifty-five or sixty days after sowing a first cutting or grazing (equal to 8 tons

per acre) may be obtained. This will be in January. If a large area of cotton has to be planted, a part of the clover land is now plowed, the remainder being allowed to grow a second crop of clover, which will be cut early in March, or about fifty days after the preceding one. Three or four cross plowings are then given, according to the condition of the land. The native plow does not invert the soil; it is merely a one-tined grubber, working to a depth of about 6 inches and breaking from one-half to three-fourths of an acre per day. The one-way balance plow is occasionally used, followed by the native implement, acting as a subsoil stirrer. Three plowings, two with the balance and one with the native plow, suffice. The land is cultivated by this means to a depth of 13 inches.

After the second plowing a harrowing is given with the native harrow. This consists of drawing a plank of wood about 10 feet long, on which a man stands, across the land, to break the lumps and level the surface. A crosskill roller is in use on some lands and is found very serviceable. It is of great importance to keep the land level in Egypt, or the irrigation water will settle in the lowest places and cause great harm to the growing crop.

For cotton a friable condition of the soil is necessary. If too coarse, germination is slow and uncertain, but if on the other hand too fine, the land becomes hard, owing to the evaporation of irrigation water applied after planting.

After the preparation of the land is completed ridges are made, by a moldboard plow, about 35 inches apart. If the time for planting has not yet arrived, the land remains ridged until planting, when new ridges are made by splitting the old ones. Many allow the land to remain flat in the interval. This, however, is not to be recommended. In any case it is considered advisable to prepare the land some time before planting, in order that it may lie at least ten or twelve days exposed to the air, sun, and other agencies.

Regarding manures, it may be said that on a considerable proportion of the cotton area the crop is grown without any whatever. Some apply barnyard manure to the extent of 10 or 15 tons per acre; and, generally speaking, except on the richest land, it is acknowledged by experienced growers that the crop repays the cost of application, especially as the manure can be purchased for 20 cents per ton.

The time at which the manure is applied varies considerably. Some spread it over the land and plow it in before making the ridges. Others ridge the land and spread it in the furrows, subsequently covering it by splitting the old ridges. Either of these methods is suitable and preferable to the system of applying it after planting, which is perhaps more common than the other. When the cotton is a few inches above the ground the manure is either spread in the furrows and hand hoed in or a handful is put under the roots of the young plants. This latter method involves more labor than any other and has no advantages.

Fresh manure is not thought so good as that which has been in the heap for two years, and old manure is always used by the best growers.

For the production of manure earth is used as a litter, and the composition of the resulting manure depends, therefore, to a considerable extent on that of the earth used. It contains but little water, 5 or 6 per cent being an average. As the result of several analyses made by Dr. Mackenzie the manure may be said to contain: Nitrogen, 0.4 per cent; phosphoric acid, 0.25 per cent, and potash, 1.5 per cent.

Following clover, as cotton almost invariably does, it finds, except on very poor land, a sufficiency of nitrogen if the fodder crop has been grazed. If cut and removed, the case may be different. After a fallow the land is generally manured, as the land selected for this purpose is of poor quality and more benefited by its application. No artificial fertilizers are applied in practice, and as yet no experiments of a reliable nature have been made to ascertain their effect.

VARIETIES.

Before proceeding further it may be advisable to give a few particulars regarding the varieties of cotton grown in Egypt, not from a botanical point of view, but merely from an agricultural standpoint. With regard to the general management, watering, etc., very little difference is observable with the several varieties, but where any does occur attention will be drawn to it.

Mitafifi.—Undoubtedly the chief variety of cotton in Egypt is Mitafifi, so called from a village in the Galiubieh province, where it was first grown. It constitutes a very high percentage of the total production of the country, and the price at which its fiber is sold forms a basis for that of the other varieties. One of the chief advantages which it possesses is hardiness, for it is by no means as sensitive to climatic changes as many of the other varieties. The plant is normal in size, but not so large as Bamia. It is not so early as some other kinds, Hamouli, Ashmouni, and Abbasi being earlier, while Bamia is later. As regards sowing, quantity of seed used, watering, picking, etc., the particulars given in another part of this bulletin refer to this variety.

The fiber of Mitafifi is yellowish-brown in color, long, generally very strong, and fine to the touch. There is a great demand for it, in fact, it leads the market. The total production per acre is good, being on an average higher than that of any other variety. It is true that in certain favored districts Abbasi may rival it in this respect, but no other variety appears to yield 500 or 600 pounds of lint on average soils.

The bolls are round and rather small, but the cotton is easily picked. Ginning is easy, and from 105 to 109 pounds of fiber are obtained per cantar.

The seed of the different kinds of cotton can not be readily distinguished. That of Mitafifi is black, with small tufts of green fiber at the ends. Its market value is a very little less than that of Abbasi

and Bamia seed, but practically speaking an ardeb[1] of the different varieties is valued at the same price.

In brief, it may be said that Mitafifi is par excellence the cotton of Egypt. New varieties are being introduced, some of which give good results at first, but it seems doubtful whether many of them can retain their good qualities and at the same time compare with Mitafifi in point of yield and hardiness. The latter grows well over the whole of the cotton-growing district, while some of the other varieties, such as Abbasi, only produce the best results in certain favored districts.

Bamia.—This is perhaps the most extensively cultivated variety in Lower Egypt after Mitafifi. It has been grown for a longer time than the latter, being discovered by a Copt in 1873, while Mitafifi has only been grown for about twelve or thirteen years. Bamia is larger and coarser in growth than other kinds, and consequently requires more water. The plants are not branched, the bolls being carried on slender stems springing from the main stalk. It is not so hardy as Mitafifi and is a little later in coming to maturity. The fiber is poor compared with Mitafifi and Abbasi. It is light brown in color and not very strong. The length of staple varies considerably, the best grades having a fair length, but some of the fiber on the market is very inferior. Viewed generally, it does not possess either the length or strength of Mitafifi, although it must be remarked that the length of the latter is very variable, that received from some districts being rather short.

The seeds are a little larger than those of other varieties. They are of a light coffee color, and less coated with fiber than Mitafifi. Their market value is about the same as the latter, being, if anything, a little higher.

The yield of fiber per cantar (315 pounds) of seed cotton is small. It varies from 95 pounds to as much as 103, but the latter amount is attained only from very good samples. The demand for the fiber is not great. The total yield per acre is good. It is said that Bamia is more liable to be attacked by the cotton worm than other varieties. This is owing to the greater quantity of water applied keeping the atmosphere in a damp condition, and the shading of the soil by the strong growing plant.

Ashmouni.—This variety was once largely grown, but now is almost exclusively confined to certain districts in Upper Egypt where little cotton is grown. It is sown somewhat early, and like Abbasi requires warm weather for the last two months of its occupancy of the soil. The plant is smaller than that of other varieties, and the total yield of fiber per acre is in most cases little more than one-half that of Mitafifi. The result of ginning is also unsatisfactory, for it gives only 90 or 95 pounds of fiber per cantar.

The crop is worth $1 per cantar less than Mitafifi. The seed of this variety is clean, black, and rich in oil.

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[1] An ardeb is 5.4 bushels.

Abbasi.—This variety is of very recent introduction, and was obtained by selection from Zafiri, which was in its turn obtained from Mitafifi. It is not yet extensively grown, although on many of the large estates it is found. Small growers are, however, very slow to attempt experiments with any recent introduction.

As regards size, it is similar to Mitafifi, but it is sown a little earlier. As already mentioned, it requires warm weather during October and November to open the later bolls. In certain districts it excels Mitafifi in point of yield, while in others, whose climatic and soil conditions are apparently the same, the result is not so satisfactory; although with average soil, good cultivation, and careful watering a good yield is generally obtained. It grows best on a loamy soil rather than on a heavy clay. Its fiber realizes the highest price in the market, at least the first two pickings do. Frequently $1 or $2 per cantar more than Mitafifi are obtained. The last picking is inferior, and sells for less than the Mitafifi.

The lint is of a beautiful white color, fine, silky, and very long, though not so strong as Mitafifi. The quantity produced finds a ready market.

The seed is a little more valuable than that of Mitafifi, and is also smaller and less coated with fiber. It has a somewhat reddish tinge. Abbasi yields, at least in the early pickings, a greater quantity of fiber per cantar than any other variety. Good crops will furnish 110 pounds per cantar, and sometimes more. Some growers give instances of a much greater quantity being obtained, but the above figure may be taken as an average.

Ginning this variety is rather more difficult than with Mitafifi, on account of the greater length of fiber, which is not accompanied by increased strength.

Zafiri.—As already stated, this variety was obtained by selection from Mitafifi. In size, time of sowing, treatment, etc., it resembles the latter. It is not extensively cultivated.

The yield per acre is not so great, although the fiber is a little more valuable than that of Mitafifi, but less so than that of Abbasi. The fiber is whitish in color, shiny, and fairly strong. In length its place is between Mitafifi and Abbasi.

Hamouli.—This variety is not now grown to any extent, although it yields a good crop and is very early. The plant is somewhat small. The fiber is rather short, fine, and fairly strong. Its color is pale, yellowish white. The demand for it is small. Consequently its price is below that of Mitafifi, and it is often very difficult to dispose of. It yields a good proportion of fiber to seed, as much as 110 pounds being obtained per cantar. The seed is a little less valuable than that of Mitafifi.

Sea Island.—This kind of cotton has been grown in Egypt for thirty or forty years, but is now almost extinct. It gives a small yield per

acre, takes a long time to ripen, and is little in demand. The yield of fiber per cantar is also unsatisfactory. The cotton of this variety is difficult to gin, being long, thin, and easily broken.

Gallini.—This variety was derived from Sea Island cotton, and closely resembles it. It will grow on salt land better than other varieties.

Common White or Ziftawi.—This variety is supposed to be of Indian origin. It gives a good yield, but the fiber is not in great demand, and consequently the area it occupies is small. The fiber is white and of moderate length and strength. The quantity yielded per cantar is satisfactory, ranging from 105 to 110 pounds. The seed is black, clean, and is rarely seen on the market. It may be mentioned that this variety grows better on the heavy black clays than the other kinds. There are several local varieties, and the price obtained for the crop differs greatly. Occasionally "fancy" prices are obtained.

These are the principal varieties of cotton grown in Egypt. There are one or two other kinds, which are principally of local interest only, and have not yet attained a position worthy of mention.

PLANTING, IRRIGATING, AND CULTIVATING.

The land being ridged, as explained on page 14, planting takes place during the month of March. The length of the ridges varies greatly; generally speaking, they are not more than 36 feet long. The object of having the land thrown into such short ridges is to facilitate watering. In many cases they are only 24 feet in length, though, on the other hand, where the land is quite level they may be 75 feet long. Small cultivators possessing only 1 or 2 acres of cotton have the ridges of less length than large planters, in fact as short as 12 feet. This involves more labor, but the land need not be so level or so carefully ridged.

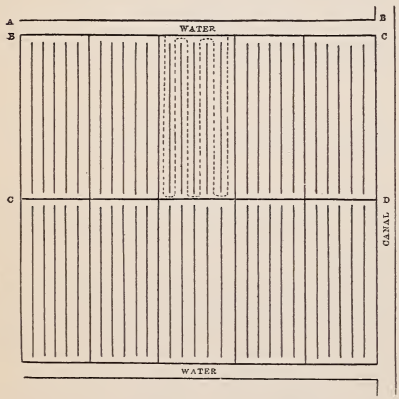

FIG. 1.—Arrangement of ridges for irrigation.

In any case the ridges are intersected by cross furrows for the purpose of watering, and six or seven furrows are irrigated at a time. The arrangement will be easily seen from the above diagram.

AB and BC are ridges; between them runs the irrigation water admitted from the canal. The ridge BC is broken to let the water into the cotton furrows. It then runs down one furrow until stopped by the ridge CD. It then flows up the next furrow, and so on until six furrows have been irrigated. It will be noticed that every sixth ridge meets the cross ridges at both ends. When the cotton is somewhat advanced in growth (after three or four waterings), more furrows are

watered at a time, perhaps twelve or eighteen; that is, the connection between the ridges and cross ridges is broken at intervals, so that two or three sets of six ridges each may be irrigated by breaking the cross furrow at one place.

The system common in many parts of India of sowing another crop between the rows of cotton is not practiced to any extent in Egypt. Occasionally small growers plant melons on the side of the ridge opposite to that on which the cotton has been sown, but this is very rare.

There are two systems of planting used in Egypt, known respectively as the wet and the dry. In the former, before planting water is run in the hollows between the ridges until it rises about two-thirds up the slope of the furrow. After eight days, the land is dry, but a line is left showing the height to which the water has risen, and along this line the seeds are deposited on the slope most exposed to the sun. The ridges run east and west, and the seed is planted on the south side. The cross ridges, made for watering purposes, of course run north and south, and the seeds are placed on the eastern exposure.

The quantity of seed used is the same for all varieties, viz, about 1½ bushels per acre. For twenty-four hours before planting the seeds are soaked in water, and any which rise to the surface are discarded. In some cases animal excrement is mixed with the water, but no advantage is gained thereby. The operation of planting is very simple. Men with the fass (a kind of hoe) make holes in a very rough manner at the required distance apart, and boys follow, depositing from 8 to 15 seed in each hole, which are immediately covered with earth. The holes are entirely filled, so that the ridges are left quite regular. Three men, with an equal number of boys, will plant an acre per day, at a cost of 60 cents. The depth at which the seed is placed should not exceed 3 inches. In ten or twelve days the plants appear above the ground. On the State domains of the Egyptian Government a hoeing is given twenty days after this, and the plants are thinned, all except the two strongest being removed by hand. Five days subsequently the first irrigation is given, the water being applied in limited quantity; that is, only until it reaches half way up the slope of the furrow. This first watering thus takes place about thirty-five days after planting, but it is not by any means definitely fixed. It may be twenty-five, thirty, or even fifty days, depending on the date of sowing and the state of the weather (temperature).

It is not the common practice, however, to thin the plants until after the first watering. A hoeing may or may not be given before the first watering, depending on the condition of the land as regards weeds. About fifteen days after the first watering the land is hoed in any case (and generally thinned), followed in ten days by the second irrigation. It is to be noticed that two plants are left growing together; occasionally a single plant only is left, but this is very exceptional indeed. Ten days after the second watering another hoeing is given, followed after an equal period by the third watering.

Three hoeings are generally given, each costing about 40 cents per acre. During the operation soil is removed from the opposite slope—that is, the old crests of the ridges are destroyed—so that the plants are left growing in the center.

Occasionally, though not generally, earthing up with a double mold-board plow takes place after the last hoeing. After the third watering, irrigations are given at regular intervals of twelve or fifteen days. Much is left, however, to the judgment of the individual cultivator.

Some apply water every ten days, but this is believed to be too frequent unless on light lands, encouraging, as it does, a greater growth of wood than is desirable. About eight waterings will be given before the first picking, which takes place in the latter part of August or early in September.

The "dry" method of planting, which is the one most extensively used, differs from the "wet" in that the land is not watered before planting the seed. The soil is prepared and ridged as in the other system. The seed is sown in a similar manner, but the men have no line to guide them, and thus to deposit the seed at the same level requires more care. If this is not exercised, difficulty will arise in the watering, for some plants will be submerged, while others will stand high and receive no water at all.

As soon as planting is completed, a watering is given, whereas in the wet system the first irrigation is not given until thirty-five days have elapsed. The time of the second watering depends so much on the date of planting that it is almost impossible to state a definite number of days. For instance, cotton planted by the dry method this year (1896) in February received its second watering forty days after the first, whereas to some late crops planted in April it was applied after an interval of only sixteen days. After the second watering the land is hoed and the plants are thinned. Subsequent treatment is similar in every respect to that given in the wet method. Possibly only two hoeings are given if the land was well prepared.

One advantage of the dry method is that if the plant fails from any cause replanting may take place without previously watering the land, for the soil has retained considerable moisture. In the wet system, where the land is watered previous to planting, delay is caused by having to wait until it is sufficiently dry to admit of planting. This makes the crop late, which, as already pointed out, is a great disadvantage.

The quantity of water applied at each watering of the cotton crop amounts on an average to about 12,250 cubic feet, equal to a uniform depth of about 3½ inches over an acre. It has been stated that planting takes place in March, but during recent years there has been a great tendency toward early planting. During the present season some cultivators began as early as February 10, and their crops made excellent progress. The months of February and March vary but little as regards climatic conditions, as will be seen from the tables already

given. It is true that early in the latter month cold winds often prevail which may check growth; but, on the other hand, the assertion is freely made that there is less damage done by the cotton worm, especially by the early brood, and that a higher percentage of bolls open—advantages which outweigh the objections.

A universal practice exists in Egypt of sowing teale (*Hibiscus cannabinus*)[1] around the cotton fields for protection from cold, sand storms, etc. The seeds are sown the same time as the cotton, not as a thick belt, but merely about 9 inches in width. The plant grows fairly rapidly, and soon reaches a good height. At the end of September or in October it is cut, steeped in water, and the fiber obtained used for making ropes, etc.

It was at one time common with some growers to cut off the growing top of the cotton plant after the bolls were formed. By doing so, they maintained, the quantity of fiber was increased and its quality improved. The practice has now practically died out.

The distance between the rows of cotton has already been stated to be 35 inches, and it is almost invariably so. This is not true with regard to the distance between the plants, i. e., between the holes in which the seeds are deposited. The distance varies from 14 to 20 inches, depending on the nature of the soil. On poor lands the seed is sown at the lesser distance, while on rich soils it is recommended to sow 20 inches apart. Considerable differences of opinion exist among large growers as to the most suitable distance, but it is really a matter on which each individual cultivator must form an opinion based on observations and results obtained on his own land. It is maintained that if planted too close together the crop is more liable to attack by the cotton worm, and even if it escapes this pest that the fiber is not of the best quality. This is true, and yet on some soils, if planted too far apart, a great growth of wood results. Much depends on the watering. Great care is necessary in this matter, more than is usually given to it, especially by small growers, who think that when they have a supply of water they must of necessity apply it. Many irrigate their cotton every ten days. This is believed to be too often, except on certain classes of soil. Again, many water at regular intervals without any regard to the appearance of the crop or the state of the weather. If there is a tendency to coarse growth and the production of much wood, it may be checked by judiciously withholding water. Thus the question of planting close or far apart is intimately connected with the watering of the crop. The quantity of water given to all varieties is practically the same, except in the case of Bamia, which, on account of its stronger growth and large leaves, requires more.

The position of the cotton crop in rotation has to some extent already been dealt with. In the cotton-growing district the land is cropped under a three or four years' course, cotton being grown once during the

[1] Ambari hemp.

rotation. The following examples of rotations of three and four years' duration, respectively, practiced largely in Egypt, will be found interesting and show the general cropping of the land:

Rotations followed in Egypt (three years).

	First year.	Second year.	Third year.
Winter	Clover or beans	Wheat, barley, flax, or potatoes.	Clover sown among standing maize.
Summer and nili (flood).	Fallow till November or maize.	Maize	Cotton.

Rotations followed in Egypt (four years).

	First year.	Second year.	Third year.	Fourth year.
Winter	Clover till June		Clover, beans, or cereals	Wheat.
Summer and nili (flood)	Fallow	Cotton	Sesame or maize	Maize.

Rotations admit of almost endless variations in Egypt, for there are numerous crops which can not be called important, but which are nevertheless grown in certain particular districts, such as indigo, lentils, tomatoes, rice, etc. Though this is so, the position of cotton is almost invariably the same, viz, after clover or a fallow, and occasionally after beans.

A fact of merely theoretical interest is that it has been tried to obtain a second crop of cotton by allowing the plants to remain in the land for another year. After the last picking in November, the land is left until March, when it is watered. Shoots are at once sent out, and the crop is then treated as under ordinary circumstances. It is almost needless to say that the yield is small and the fiber of inferior quality, being bad in color, short, and brittle. The crop is, however, very early.

INSECT PESTS.

Two insect pests cause great damage to the cotton crop of Egypt, viz, the cotton worm and bollworm.[1] A small bug is found in damaged bolls, but this may be neglected, as the damage it does is slight.

The cotton worm.—The damage done by the cotton worm is local, for it appears in various provinces each year, while in others it may be almost altogether absent. It does not appear in the same district each season. Its attack is not confined to this one particular crop, but it feeds also on wheat, barley, maize, clover, and potatoes.

The female lays her eggs on the under surface of the leaf of the cotton just after it has appeared above the ground. It is worthy of notice, however, that only one or two leaves of the plant are selected. This is of great importance, for at subsequent stages the chief remedy used is

[1] U. S. Dept. Agr., Office of Experiment Stations Bul. 33, p. 317.

hand picking the leaves, which could not be adopted were it not for this fact.

The average time of incubation is three days, but it varies considerably, cold weather retarding while warm suns accelerate it. The caterpillar when it first emerges is greenish in color and covered with short hairs. It immediately begins to feed on the tender part of the leaves. For five or six days it grows rapidly, and then quitting the leaves it enters the soil and eats through the tender part of the stem underneath the surface, the result being that the plant withers and dies. In the early morning the worms are to be seen in quantity in the furrows, migrating to fresh cotton fields or to the nearest clover. The adult worm varies in color from a ground shade to a greenish black with darker longitudinal lines on its back. When about 2 inches in length it burrows into the soil to a depth of as much as 3 inches and passes the pupal stage. The pupa is of a brownish-red color, and in seven or eight days the mature insect appears, and after twenty-four hours proceeds to lay her eggs.

There are five broods in Egypt during the year. The first appears in April, when the young plants are a few inches above the ground and in succulent condition. The damage done by this brood varies greatly. In the majority of cases the worms are not in great numbers, but in some instances the whole crop is destroyed and replanting has to be resorted to. The method used is generally to be condemned. The plants not destroyed are allowed to remain and fresh seed deposited in the same ridges. The result is that the worm lives in the meantime on the remaining plants, and when the freshly sown seed has germinated and the plants are appearing above the ground they are eaten off below the surface of the soil, and resowing has again to take place. Instead of this system the land should be flooded after splitting the ridges and new ridges made. One objection to this may be the loss of time, and since this is so it provides an excellent reason for early planting. The first brood appears every year almost at the same time, and by planting early the crop is better able to resist its attack. With regard to this first brood experiments are being made to test the efficacy of paris green, and by checking the worm at this stage to reduce the great damage which is caused by subsequent generations. Other remedies are tried, the chief one being to water the land. The effect of water is most pronounced on full-grown worms when about to enter the chrysalis stage. When young or half grown the worms are very active and many of them escape. When the next irrigation is given, in ten or twelve days, these worms will either be full grown and be destroyed, or they will be in the pupal state and then become embedded in mud, so that the perfect insect is unable to escape. Unfortunately, however, watering, though successful in destroying considerable numbers of the pest, may be injurious to the cotton if the water is applied too frequently and when unnecessary. Another plan sometimes adopted

is to place small quantities of green clover along the rows at intervals of 10 or 12 feet to attract the worms. This may be successful with those worms which are not full grown.

For spraying purposes kerosene and soft soap emulsion has been tried, but only proved a partial success.

Fortunately the first brood is not general, and where it does appear the worms are generally seen in the clover land when it is being prepared for cotton. In this case a good flooding should be given and the land well plowed to expose them to their natural enemies.

Up to the present time nothing has been done to keep the first brood in check, and consequently the second generation, which appears late in May, is more numerous and destructive. The remedies used at this stage are hand picking the leaves and flooding. The former is no doubt very effective. A number of boys are sent to the fields to pick the leaves, which they subsequently burn.

The third brood appears in August, and often proves the most destructive. The remedies used are the same as those in the case of the preceding. After a flooding an application of tar and carbolic acid has been applied to the trees in some places, to prevent the worms which escape the water from climbing up. Up to the time of the second brood clover occupies the land (it fails in June on account of the heat), and this provides additional food for the pest.

Sometimes a trench is dug around an area of cotton, which is kept filled with water, for the worm has great migratory propensities, and when a crop of cotton has been destroyed they go to the neighboring clover.

The worm is supposed to hibernate in the pupal state, but it is almost certain that under favorable circumstances the worm exists during the winter. They are found practically all the year round. The fact that they are seen between the periods at which the broods generally appear merely shows that the broods overlap, the late hatchings of one feeding at the same time as the early hatchings of the following brood.

After the third brood in August the cotton suffers no more damage from the worms. The remaining two generations attack the clover, newly sown in October, cereals, maize, etc.

It has already been pointed out that cotton is preceded by clover and this again by maize, sown in July. Unfortunately it is a very common custom to sow the maize without previously plowing the land; and if instead of sowing maize the land is fallowed it often remains unplowed. These practices are to be condemned, for by turning up the land and flooding the worm would be destroyed. The advisability of plowing, in preparation for cotton, some time before it is intended to sow, has already been touched upon.

The bollworm.—The bollworm is said by some to do even more damage than the cotton worm. Its ravages are general and not confined to various districts, as the attacks of the cotton worm usually are. In

addition, the bollworm is more difficult to combat. The female lays her eggs singly on the bolls, commencing usually early in the month of August and continuing until the crop is removed. The larva entering the boll causes it to prematurely open and yield fiber which is bad in color, short, and brittle. It is quite unnecessary to enter into any details concerning the history of the pest. It may be said, however, that no remedies are adopted. The use of lamps and various liquids at night to trap the moths have been tried, but it was found that though some were captured, the number was not large, and the destruction of natural enemies of the pest considerably detracted from the value of the remedy.

The practice of storing cotton wood on the land is to be condemned, for during the winter it harbors the moth. At night, if such a heap be disturbed, numbers of the green moth immediately fly out.

The damage done to the cotton by the bollworm makes it more difficult to gin.

PICKING.

The chief points of interest relating to the general management of the crop up to the time of ripening having now been stated, we arrive at the picking of the fiber.

The first picking is supposed to begin by September 10, but it may be a few days earlier or later, depending chiefly on the climatic conditions which were prevalent during the first period of the growth of the plant. A number of boys are sent to the fields, each provided with a small basket. They pick the fiber from the bolls which are fully opened, a mere touch almost sufficing to remove it. The land is dry during this operation—that is, eight or nine days are allowed to elapse after the previous watering, to prevent the ill effects of trampling. Care is taken to see that the crop is picked clean, for any fiber that is left will drop out and be lost before the next picking. The price paid is about 20 cents per 100 pounds of the fiber and seed. A boy will gather from 30 to 40 pounds a day.

After the first picking the land is watered, and another gathering takes place in October. These two pickings give the best fiber, the last crop being small in quantity and poor in quality. It is not mixed with the others, but sold separately.

The third or last picking is obtained in November, the land having received a watering after the preceding picking. No exact information can be given as to the number of days which elapse between the various pickings. Whenever it is seen that a sufficient number of bolls are open the fiber is gathered. The interval may vary from twenty-five to thirty-five days. The first picking contains the greatest proportion of fiber to seed, and the last the smallest. Some growers take a final picking the latter part of November, or even early in December, thus bringing the total number to four.

About twelve or fifteen days before it is intended to finally remove

the whole crop from the ground, the land is watered and clover seeded broadcast among the standing plants, so that when the wood is cut the forage crop covers the land. Small cultivators sometimes plow their land after cotton before sowing clover. In order to do this the fiber crop must be removed earlier, and only two pickings can be taken. The practice of sowing the clover among the standing cotton is, however, the more common.

The quantity of cotton yielded by the different pickings is not equally divided. As a rule 35 per cent of the total is obtained at the first picking, the second and last yielding 45 per cent and 20 per cent, respectively. It has already been stated that the last picking of the crop is less valuable than the others. The deterioration which takes place is much greater with some varieties than with others. Abbasi cotton, a newly introduced variety, produces beautiful white, long, silky fiber at the first and second pickings, but the subsequent pickings are very poor.

DISPOSAL OF THE PRODUCT.

Cotton is sold in Egypt by the cantar of 315 pounds of the mixed fiber and seed, and the price varies from $9 to $13, according to the variety and the state of the market. When ginned this quantity of seed cotton is supposed to give the following products:

Results of ginning a cantar (315 pounds) of seed cotton.

	Pounds.
Fiber	100
Seed	210
Loss, waste, etc	5
Total	315

When purchasing, merchants speculate as to the quantity of fiber which a cantar of the material will produce. Some varieties give as much as 112 or 115 pounds, while others furnish only 90 or 95 pounds. On an acre of good average land 5 or 6 cantars are obtained, equal to 500 or 600 pounds of lint. This is not a high yield, for 700 or 800 pounds of fiber are obtained on good land if well cultivated and a moderate application of barnyard manure given.

A small quantity of seed is crushed and used in the country for feeding working bullocks and cows, the bulk of the crop produced, however, being exported. It is sold by the ardeb of 5.4 bushels, and the market value of the different varieties is practically the same.

GINNING.

Ginning in Egypt is carried on at various centers throughout the country, and the resulting fiber forwarded to Alexandria for shipment. Cotton sales are held at these places, and during the season the factories are kept constantly at work. Small growers often bring in their produce in an unsatisfactory condition, and add water to it in order to

increase its weight. This has the effect also of altering the color of the fiber. The gin almost invariably used in Egypt is that known as Macarthy's Patent Self-feeding Single Action. It is particularly suited to long staple cotton, and separates the seeds without crushing, while the fiber is as a rule uninjured. The 40-inch gin so commonly used costs when complete with roller shafting, etc., about $150. The gin alone costs $90. It is said to require only 1½ indicated horsepower to drive it, but in practice from 3 to 4 horsepower is allowed. The quantity of cotton turned out per hour varies according to the speed at which the gin runs. It is supposed to give a hundredweight of clean cotton per hour, but from 90 to 100 pounds is considered a good average. Running at 900 or 1,000 revolutions per minute will give 100 pounds of fiber per hour, or say from 900 to 1,100 pounds per day of ten hours. The driving pulleys being now provided with balance weights, the gin can run at an increased speed with but little increase in vibration. The size of the gin is not great, the floor space it occupies being less than 17 square feet, while the net weight is less than 700 pounds. In the factories in Egypt from 50 to 100 of such machines are used, and they sometimes run from twelve to sixteen hours per day.

Regarding the cost of working, it may be taken as a general average that 30 cents will gin a cantar of cotton, i. e., 315 pounds of the seed and fiber giving approximately 100 pounds of clean cotton. According to the reports of the State domains the ginning costs 26½ cents per cantar, and thus an acre of good cotton yielding 6 cantars would cost a little over $1.50. Various arrangements are made between the seller and the factory owner as regards price allowed for ginning. The seeds are often returned and a fixed price charged, while sometimes a certain price is given for the seeds and the cost of ginning allowed for in fixing this price.

COST OF GROWING COTTON IN EGYPT.

In conclusion, a few facts may be of interest concerning the cost of growing an acre of cotton in Egypt. This naturally varies in the different provinces, and it is at the same time extremely difficult to obtain reliable information. The rent of the land varies, but it may be assumed that an acre of good average cotton land is worth $21.87, not including the water supply. Much of the land is let for a less sum than this, but we may suppose that land valued at this rental will produce, say, 5½ cantars of cotton. The fiber crop does not occupy the land for the whole year, as after the crop is removed two cuttings of clover may be obtained before the end of the year, i. e., from March to March. It is nevertheless necessary to charge a full year's rent to the cotton, as it is the exhausting crop of the rotation. On poor soils, as already mentioned, a fallow often precedes it, which extends from May or November to the following March, and the cost of this, or at least the greater part of it, must be borne by the cotton crop.

The taxes amount to approximately $4.86 per acre. It would serve

no useful purpose to explain the system of land taxation in Egypt, but in some cases the amount levied is much less than that stated, while in some instances it may be more. Up to the present time the sum has by no means been proportional to the value of the land.

One of the most important items in the cultivation of cotton is the cost of irrigating. On the large estates where engines and pumps are in use the actual cost of watering an acre is about 50 cents for each application. With small cultivators, who have to lift their water by means of roughly constructed wheels worked by bullocks, or other lifts, the cost is much greater, and pump owners who irrigate such small areas generally charge a very high price. Under favorable circumstances, to water an acre of cotton costs $7 or $8, and in some cases more.

Practically all the land is cultivated by means of bullocks, and 20 cents may be allowed for the work of each animal per day. To plow an acre of land costs on this basis approximately $1.

Taking these figures, the expenditure involved in the growth and cultivation of an acre of cotton may be summarized thus:

Cost per acre of growing cotton in Egypt.

Rent of land, including taxes	$27.00
Irrigation	7.00
Preparation of land, seeding, manuring, etc	5.50
Cost of seed	.50
Cultivation, including hoeing, thinning, etc	2.00
Picking	4.00
Total	46.00

The return from lint, seed, etc., is $66, thus yielding a profit of $20 per acre. It will be understood that these figures are by no means absolute; they are mere approximations. In many districts with favorable seasons the profit may be even more, while in some provinces it is less. It is generally recognized that at present cotton is the most profitable crop in Egypt, especially since the decline in the price of sugar.

EXPORTS OF COTTON FROM EGYPT.

By Frank H. Hitchcock,

Chief of the Section of Foreign Markets, United States Department of Agriculture.

One of the most interesting features of the present cotton situation, viewed from a commercial standpoint, is the growing importance of Egypt as an exporting country. In 1879, the first year for which there are official statistics as to the quantity of cotton shipped from Egypt, the total exports were returned at 270,060,813 pounds, whereas in 1895, the latest year for which we have figures, the exportations amounted to 521,427,463 pounds, or nearly double the quantity shipped in 1879.

The following table, compiled from the annual trade reports published by the Egyptian Government (Le Commerce Extérieur de l'Égypte), shows for as many years as are covered by the official statistics the total quantity and value of cotton exported from that country, and also the average export price per annum as computed from the returns of quantity and value. To render more intelligible the Egyptian statistics of quantity and value, they have been converted[1] into the corresponding denominations employed in the United States. In the present table the Egyptian denominations, as well as those of the United States, are given. The figures are as follows:

Quantity, value, and average export price of cotton exported from Egypt in the years 1874 to 1895, inclusive.

Calendar years.	Quantities.		Values.		Export price per pound.
	Cantars.	*Pounds.*	*£ E.*	*Dollars.*	*Cents.*
1874	.....	.....	9,676,283	48,129,832	.....
1875	.....	.....	8,853,635	44,037,980	.....
1876	.....	.....	8,762,712	43,585,729	.....
1877	.....	.....	7,158,641	35,607,080	.....
1878	.....	.....	5,003,510	24,887,459	.....
1879	2,726,532	270,060,813	8,118,852	40,383,170	14.95
1880	2,558,461	253,413,515	7,467,776	37,144,718	14.66
1881	3,147,596	311,766,866	8,890,630	43,564,087	13.97
1882	2,562,960	253,859,138	7,385,986	36,191,331	14.26
1883	2,611,840	258,700,662	7,465,731	36,582,082	14.14
1884	3,073,570	304,434,650	8,237,749	40,364,970	13.26
1885	3,188,821	315,850,169	7,706,399	37,761,355	11.96
1886	3,040,803	301,189,104	7,120,812	34,891,979	11.58
1887	3,067,013	303,785,184	7,542,567	37,282,909	12.27
1888	2,691,835	266,624,103	6,823,311	33,727,626	12.65
1889	3,206,202	317,571,743	8,547,716	42,251,360	13.30
1890	3,328,223	329,657,826	8,272,226	40,889,613	12.40
	Kilograms.				
1891	191,538,676	422,269,996	8,988,826	44,431,767	10.52
1892	228,463,082	503,674,280	8,838,034	43,686,402	8.67
1893	201,288,677	443,765,043	8,525,974	42,143,889	9.50
1894	242,758,850	535,191,016	8,181,170	40,439,523	7.56
1895	236,515,800	521,427,463	9,463,498	46,778,071	8.97

[1]According to the official trade reports of Egypt (Le Commerce Extérieur de l'Égypte), an Egyptian cantar is equal to 44.928 kilograms (99.0904 pounds avoirdupois), that equivalent having been fixed by a khedival decree issued April 28, 1891. Prior to the year 1881 the Egyptian monetary pound (£ E.), according to the reports of the Director of the United States Mint, was regarded as equivalent to $4.974 in our money. From 1881 to 1886, inclusive, it was valued at $4.90, and in 1887 and succeeding years at $4.943. These various changes in equivalents have been carefully regarded in making the conversions required in the present article.

During the period covered by the above statistics the export price of cotton suffered a decline almost as marked as the increase in the quantity of cotton shipped, falling from 14.95 cents per pound in 1879 to 8.97 cents per pound in 1895. As a result of this fall in price the total value of the cotton exported, notwithstanding the greatly augmented shipments, remained practically stationary. The average export price for the year 1895, however, evinced an upward tendency, being considerably higher than that for 1894, which was only 7.56 cents per pound, the lowest price recorded for any year.

As regards the destination of the cotton exported from Egypt, the official trade reports of that country do not afford very full information, except for the more recent years. Such statistics on the subject as have been published in these reports during the past ten years are summarized in the tables presented below. These tables are arranged to cover the two quinquennial periods 1886–1890, and 1891–1895, respectively, showing the quantity and value of cotton exported yearly to the principal countries of destination, with annual averages and percentages for each period. It should be stated by way of explanation, however, that the countries to which the figures are credited do not necessarily represent in every case the final destinations of the cotton shipped to them, a considerable portion being undoubtedly redistributed to other countries. The tables are as follows:

Quantity and value of cotton exported from Egypt to the principal countries of destination during the five years 1886–1890.

QUANTITIES.

Countries of destination.	1886.	1887.	1888.	1889.	1890.	Annual average, 1886–1890.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Per ct.*
United Kingdom	185,151,877	193,770,544	160,404,633	198,140,991	205,321,959	188,558,001	62.08
Russia	44,589,077	36,818,866	37,240,815	31,136,413	40,379,090	38,032,852	12.52
Austria-Hungary	24,291,321	23,064,795	25,065,787	35,206,642	30,085,600	27,542,829	9.07
France[1]	26,362,242	23,243,678	20,633,335	24,642,946	23,687,319	23,713,904	7.80
Italy	16,184,937	21,407,503	17,976,934	22,912,853	23,312,616	20,358,969	6.70
Spain	2,970,287	2,059,431	2,777,637	1,994,752	4,123,518	2,785,125	.92
Other countries	1,639,363	3,420,367	2,524,962	3,537,146	2,747,724	2,773,912	.91
Total	301,189,104	303,785,184	266,624,103	317,571,743	329,657,826	303,765,592	100.00

VALUES.

	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Per ct.*
United Kingdom	21,681,412	23,887,359	20,429,419	26,458,441	25,488,228	23,588,972	62.38
Russia	5,094,177	4,562,260	4,690,012	4,159,875	4,999,988	4,701,262	12.44
Austria-Hungary	2,740,957	2,866,569	3,137,807	4,696,918	3,874,907	3,463,431	9.16
France[1]	3,068,042	2,855,092	2,606,592	3,274,461	2,954,016	2,951,641	7.81
Italy	1,844,855	2,526,501	2,289,019	3,078,589	2,904,225	2,528,638	6.69
Spain	352,648	259,928	363,795	263,378	467,875	341,525	.90
Other countries	109,888	325,200	210,982	319,698	200,374	233,228	.62
Total	34,891,979	37,282,909	33,727,626	42,251,360	40,889,613	37,808,697	100.00

[1] Including a small amount exported to Algeria.

Quantity and value of cotton exported from Egypt to the principal countries of destination during the five years 1891–1895.

QUANTITIES.

Countries of destination.	1891.	1892.	1893.	1894.	1895.	Annual average, 1891–1895.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Per ct.*
United Kingdom	256,507,292	272,546,242	219,007,381	253,381,606	282,188,494	256,726,203	52.91
Russia	74,471,085	98,109,662	92,390,002	118,488,294	70,033,723	90,698,553	18.69
France	25,683,874	31,102,117	25,728,233	32,474,714	37,520,318	30,501,851	6.29
Austria-Hungary	27,299,820	29,611,872	21,166,352	29,435,755	24,739,694	26,450,699	5.45
Italy	24,884,551	28,634,533	23,988,973	31,808,037	19,001,730	25,663,565	5.29
Germany	2,163,059	17,523,883	20,432,722	16,479,755	20,414,451	15,402,774	3.17
America	2,520,494	8,537,349	10,280,527	19,064,121	23,726,341	12,825,766	2.64
Spain	4,606,856	8,555,868	12,395,798	15,757,632	14,252,427	11,113,716	2.29
Switzerland	201,540	4,751,121	10,388,158	9,352,880	20,872,130	9,113,166	1.88
British East Indies	736,504	1,258,337	2,383,487	3,274,743	5,359,762	2,602,567	.54
Turkey	1,946,684	1,965,304	1,039,137	1,232,052	1,514,684	1,539,572	.32
Belgium	93,489	318,671	696,911	2,526,054	774,152	881,855	.18
Greece	579,204	366,540	331,112	241,185	254,523	354,513	.07
Roumania	503,665	302,509	141,508	231,595	138,891	263,634	.05
Others countries	71,879	90,272	3,394,742	1,442,593	636,143	1,127,126	.23
Total	422,269,996	503,674,280	443,765,043	535,191,016	521,427,463	485,265,560	100.00

VALUES.

	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Per ct.*
United Kingdom	26,740,602	23,671,276	20,792,373	19,259,895	25,537,313	23,200,292	53.34
Russia	8,003,221	8,548,024	8,785,184	8,948,303	6,104,585	8,077,863	18.57
France	2,745,540	2,679,121	2,444,798	2,428,219	3,358,398	2,731,215	6.28
Austria-Hungary	2,932,227	2,588,699	2,016,996	2,143,428	2,182,512	2,372,772	5.46
Italy	2,643,413	2,460,057	2,297,724	2,439,499	1,671,599	2,302,458	5.29
Germany	235,905	1,537,322	1,950,705	1,251,711	1,904,835	1,376,096	3.16
America	261,707	733,403	987,621	1,397,228	2,174,925	1,110,977	2.55
Spain	467,845	756,511	1,180,413	1,228,064	1,233,323	973,231	2.24
Switzerland	20,158	424,643	994,274	711,698	1,949,020	819,959	1.89
British East Indies	82,162	107,579	233,063	246,463	437,030	221,260	.51
Turkey	167,637	89,068	43,627	48,832	60,166	81,866	.19
Belgium	10,356	28,047	68,263	190,414	69,202	73,256	.17
Greece	60,665	31,675	31,497	17,933	21,764	32,707	.07
Roumania	55,020	25,540	13,376	17,360	13,865	25,032	.06
Other countries	5,309	5,437	303,975	110,476	59,534	96,946	.22
Total	44,431,767	43,686,402	42,143,889	40,439,523	46,778,071	43,495,930	100.00

From the statistics presented in the above tables it will be seen that considerably more than half of the cotton exported from Egypt during the ten years 1886 to 1895 was shipped to the United Kingdom. In the quinquennial period 1886–1890, about 62 per cent of the total exports went to that country, the residue being consigned chiefly to Russia, Austria-Hungary, France, and Italy. During the succeeding quinquennium, 1890–1895, the distribution of Egyptian cotton became much more general. The amount sent to the United Kingdom continued to increase, but did not constitute so large a proportion of the total shipments as in the five-year period preceding, although still amounting to about 53 per cent. The exportations to Russia grew rapidly in importance, the annual average for the second quiquennium being more than double that for the first, and amounting to nearly one-fifth of the total exports. The shipments to France and Italy also increased, but those to Austria-Hungary did not average quite so large.

Among the countries not previously specified to which shipments of some importance were consigned during this period should be men-

tioned Germany, America, Spain, and Switzerland. These four countries, according to the Egyptian statistics, received about 10 per cent of the cotton exported in the five years 1891–1895. The shipments recorded as going to America amounted to only 2.64 per cent of the total. Unfortunately the Egyptian trade reports do not contain a separate statement of the cotton shipped to the United States. It may be safely inferred, however, that the exports credited to "America" in these reports come almost exclusively to this country.

Prior to 1891 these shipments were insignificant, but from that year they began to increase with great rapidity, amounting in 1895 to 23,726,341 pounds as compared with 2,520,494 pounds in 1891. It is to be understood, of course, that these figures relate solely to cotton sent directly to America. Cotton had been exported to this country by the way of Great Britain for quite a number of years, but in the Egyptian trade reports these shipments are credited to the United Kingdom. The fact of the matter is that the cotton shipped from Liverpool and other British ports to the United States has been almost entirely of Egyptian origin. The extent to which we have imported cotton through the ports of the United Kingdom will be seen from the following tables, covering the years 1875 to 1896, inclusive. These tables have been compiled from the official commerce reports published by the Bureau of Statistics of the United States Treasury Department, and besides showing our imports of cotton from the United Kingdom, they exhibit the amounts received directly from Egypt, from Peru, and from all other countries. They are as follows:

Quantity and value of cotton imported into the United States from the principal sources of supply during the fiscal years 1875 to 1896, inclusive.

QUANTITIES.

Years ended June 30—	United Kingdom.	Egypt.	Peru.	Other countries.	Total.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1875	888,738	.....	.....	1,260,594	2,149,332
1876	1,196,470	.....	.....	1,254,949	2,451,419
1877	1,983,760	.....	.....	672,807	2,656,567
1878	2,043,906	.....	.....	988,107	3,032,013
1879	2,174,553	.....	.....	819,124	2,993,677
1880	2,487,303	.....	.....	1,060,489	3,547,792
1881	2,453,495	.....	.....	1,996,371	4,449,866
1882	3,673,297	.....	.....	666,655	4,339,952
1883	3,181,910	.....	.....	900,035	4,081,945
1884	4,893,225	174,346	446	1,951,475	7,019,492
1885	3,569,549	75,772	.....	1,470,359	5,115,680
1886	3,248,637	138,792	5,135	1,679,770	5,072,334
1887	2,739,610	143,415	33,466	1,008,040	3,924,531
1888	3,926,226	519,848	28,252	1,023,266	5,497,592
1889	4,793,189	2,933,466	2,773	243,611	7,973,039
1890	5,062,058	2,947,741	301,623	294,627	8,606,049
1891	8,553,982	10,186,345	341,181	1,827,309	20,908,817
1892	8,123,795	16,763,723	1,844,999	1,931,252	28,663,769
1893	11,164,410	28,121,282	3,411,619	670,641	43,367,952
1894	7,509,773	18,338,900	1,171,515	685,761	27,705,949
1895	17,738,798	29,931,948	1,197,272	464,004	49,332,022
1896	9,530,252	43,574,769	1,661,333	584,166	55,350,520

Quantity and value of cotton imported into the United States from the principal sources of supply during the fiscal years 1875 to 1896, inclusive—Continued.

VALUES.

Years ended June 30—	United Kingdom	Egypt.	Peru.	Other countries.	Total.
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*
1875	209,487	.....	.....	199,321	408,808
1876	23',186	.....	.....	149,537	381,723
1877	327,249	.....	.....	86,254	413,503
1878	337,490	.....	.....	132,392	469,882
1879	415,569	.....	.....	84,362	499,931
1880	444,036	.....	.....	147,084	591,120
1881	454,004	.....	.....	303,304	757,308
1882	680,187	.....	.....	109,657	789,844
1883	648,008	.....	.....	152,524	800,532
1884	1,026,014	28,938	42	324,856	1,379,850
1885	678,600	12,676	.....	263,484	954,760
1886	479,769	21,950	770	170,019	672,508
1887	382,202	22,637	4,044	125,045	533,928
1888	578,912	75,337	3,088	87,463	744,800
1889	702,327	460,805	310	31,063	1,194,505
1890	843,669	460,535	50,390	38,134	1,392,728
1891	1,216,742	1,376,258	54,754	177,250	2,825,004
1892	990,742	1,856,885	267,518	102,376	3,217,521
1893	1,252,885	2,924,722	422,992	88,200	4,688,799
1894	814,535	1,930,987	166,046	92,300	3,003,888
1895	1,736,546	2,798,272	128,959	50,598	4,714,375
1896	1,189,070	5,129,256	209,319	50,567	6,578,212

According to the official statistics of our commerce presented above, the first consignments of Egyptian cotton coming directly to the United States were received during the fiscal year 1884, and amounted to 174,346 pounds. From this small beginning our direct imports rapidly increased until in the fiscal year 1896 they had reached no less a figure than 43,574,769 pounds.

It will be noticed that the returns of our importations of cotton from Egypt as given in the commerce reports of the United States are somewhat at variance with those quoted from the official trade reports published by the Egyptian Government. This is partly explained by the fact that the figures given in our reports are for the fiscal years ended June 30, while the Egyptian returns are for the calendar years. Another and more important explanation lies in the different methods of recording trade statistics employed in the two countries. As far as the general course of the trade is concerned, however, the statistics of both countries practically agree.

With the exception of Egypt, the only cotton-producing country from which the United States imports any considerable amount is Peru. The Peruvian cotton, like the Egyptian, owes its use in this country to certain peculiarities of quality that make it better fitted for some special purposes than our own varieties, but neither the Peruvian nor the Egyptian can properly be said to come into direct competition with our native cottons. As compared with the Egyptian, however, the quantity of Peruvian cotton imported is very small. The largest importation ever recorded, that for the fiscal year 1893, amounted to only 3,411,619 pounds.

It is probable that small shipments of Peruvian cotton reach the United States through Liverpool and other British ports, but the quan-

tity thus imported is comparatively unimportant. As has already been intimated, the major portion of the cotton shipped to this country from the ports of the United Kingdom is undoubtedly of Egyptian origin. During the five years just ended our imports from the United Kingdom have averaged more than 10,000,000 pounds per annum, whereas in the first five years covered by the foregoing tables, 1875–1879, the average importation per annum was less than 2,000,000 pounds. This increase was not nearly so rapid, however, as the growth since 1884 in our direct imports from Egypt.

In the figures recorded for the last few years an indication may be had of the extent to which our import trade in Egyptian cotton is being diverted from the British ports that formerly monopolized it into a more direct and natural route. Although the fiscal year 1895 was marked by the largest importation of cotton from the United Kingdom ever reported, 17,738,798 pounds, the quantity imported in 1896 fell to 9,530,252 pounds. Meanwhile our direct imports from Egypt advanced from 29.931,948 pounds in 1895 to 43,574,769 pounds in 1896. It will thus be seen that the gain in our direct trade with Egypt was very much greater than the loss in the trade coming by the way of the United Kingdom.

During the year ended June 30, 1896, according to the official trade statistics of the United States, our total imports of cotton from all sources amounted to 55,350,520 pounds, the largest in our history, and of this quantity it is safe to say that not less than 50,000,000 pounds consisted of Egyptian cotton.

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